Search for vector-like quarks

Tiago Vale, Nuno Castro

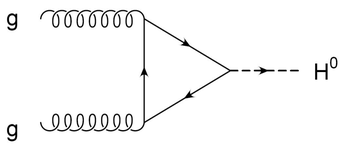
Universidade do Minho
Escola de Ciências

Jornadas do LIP
February 14 - 16, 2020
Braga

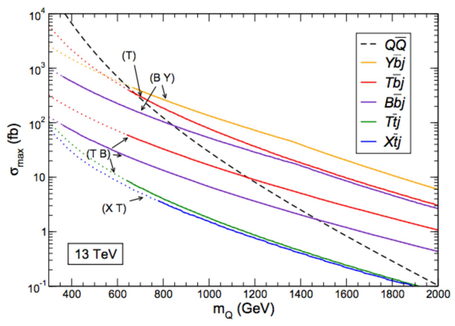
FCT Fundação para a Ciência e a Tecnologia

CERN/FIS-PAR/0002/2019,PD/BD/135435/2017, financiado por fundos FCT

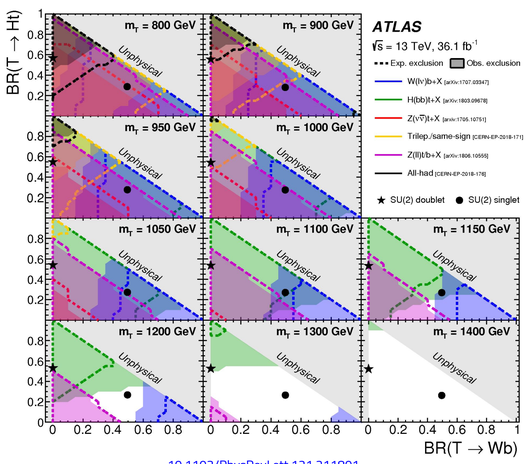
Motivation and Pheno



- Chiral quark families excluded up to ~600 GeV
- gg → H cross section would increase x10
- A new quark family with the same left- and righ-handed SU(2) charges can have a Dirac mass term
  - Avoids these constraints
- Predicted by many BSM models to tackle the hierarchy problem
  - Eg: Composite Higgs models (see posters by Maria Ramos and Guilherme Guedes, talk by Maria Ramos)



- Can be pair-produced via QCD
  - Fairly model independent
- Single-production via EW
  - Bigger model dependence
  - Dominant mechanism at high masses
- Can be SU(2) singlets, doublets or triplets
- SM-like electric charges or exotic charges of -4/3 and 5/3

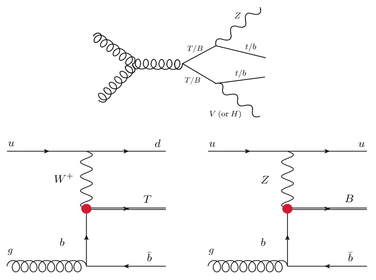


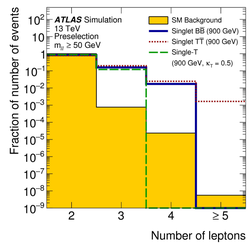
10.1103/PhysRevLett.121.211801

- 36.1/fb analysis targeted many final states
- Optimized across the BR plane
- Pair-production combination produced stringent limits
  - 1.3 and 1 TeV for T and B
- Previous iteration of the analysis presented in this paper represented in purple

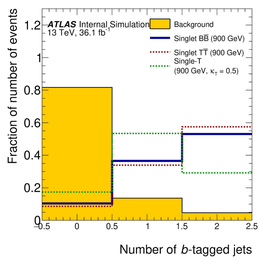
Strategy

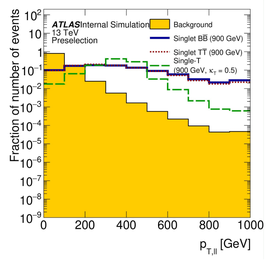
- Full run-2 data (140/fb) collected by the ATLAS experiment
- Targeting final states compatible with a Z candidate
- Considering only 3rd generation decays through SM bosons
- Assuming gluon fusion via SM gluons only

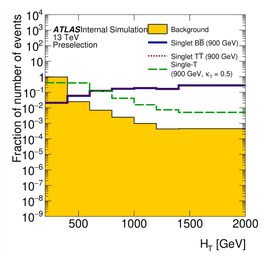




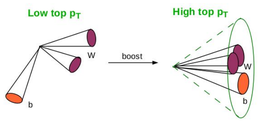
- Channels split by lepton multiplicity
  - Dilepton and trilepton channels for pair and single production
- Z candidate boost from high VLQ mass exploited in selection
- Scalar sum of jets and leptons pT (H_T) used as discriminant variable

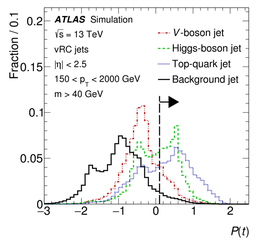


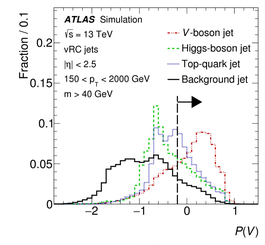


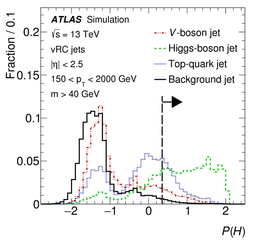


- Deep Neural Network to tag jets as W/Z, Higgs or top jets
- Signal region split by jet tag multiplicities
- Targeting different background compositions to enrich fit



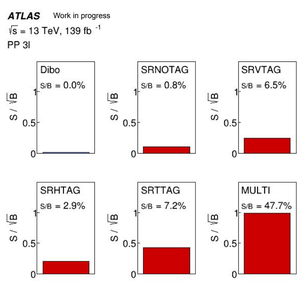




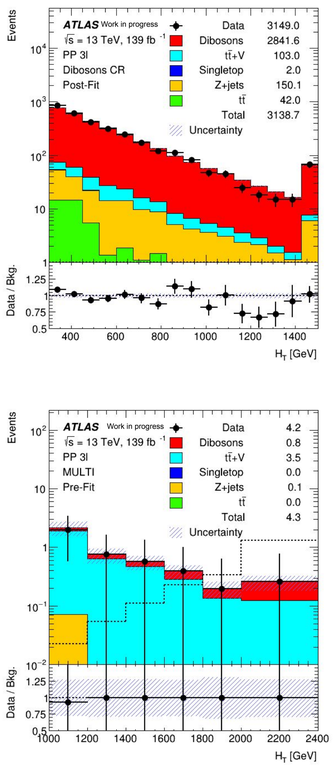


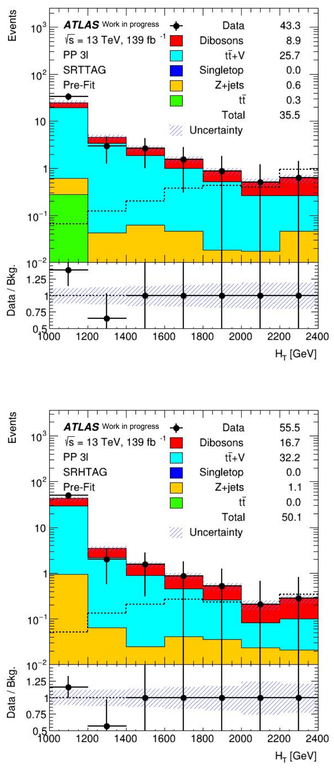
arXiv: 1808.01771

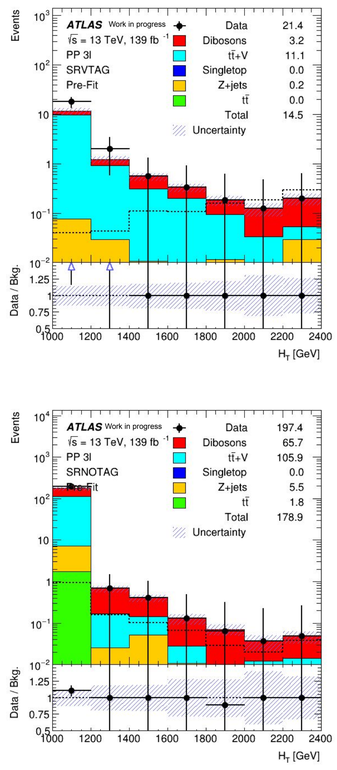
Data/Monte Carlo



- 1.2 TeV T as benchmark
- Different regions based on jet tagger
- Data in bins with S/B > 5% still blinded
- Dibosons CR with high purity and fair modelling







Profiled Likelihood fit

- Partially unblinded fit
- Main backgrounds modelling dominate the fit
- VV scales uncertainty seems to be too conservative